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Significant Learning in ESD: Guidelines for the Use of Problem-Based Learning Methodology to Promote Critical Spatial Thinking

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Summary: Concerning of teaching and learning strategies underlying an Education for Sustainable Development (ESD) approach, this study aims at proposing some guidelines for the conception of significant learning (SL) experiences under problem-based learning (PBL) methodology, to promote student's critical spatial thinking (CST) skills. The following research questions guided literature review procedure: What are the main principles that support ESD? What are the main guidelines for the conception of teaching and learning strategies on the scope for ESD? How can SL be promoted? What are the CST skills? Which student's CST skills are most relevant to promote, on the scope for ESD? The United Nations Educational, Scientific and Cultural Organization (UNESCO) embraced the Decade of Education for Sustainable Development (DESD) from 2005 to 2014. One of its main goals is to prepare citizens (teachers, pupils, parents) to face the social, economic and environmental challenges of the present world (Unesco, 2005). 'ESD is not only about teaching the subjects relevant to sustainable development but also about participatory learning process', but a complex and evolving process that 'often implies the challenge of transforming existing approaches to education' (Unesco, 2009, p. iii).

Therefore, ESD approach demands a reorientation of Education through a multi- and inter-disciplinary examination of science-technology-society interrelations, on the development of socio-constructivist teaching activities in order to promote critical reflection among pupils, about cultural, social, environmental and economic issues of the current society (Aikenhead, 2006; Trz, Carlos, Guerra, Moreira, & Vieira, 2011). Since ESD demands a reorientation from focusing entirely on providing

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knowledge towards dealing with problems and identifying possible solutions, education should open the door to multi- and inter-disciplinary examination of real-life situations (Unece, 2009). PBL should then be considered as an appropriate methodology for ESD, since it's characterized by contextualized problem-setting and situations, with content being introduced in the context of real-world problems, 'used as a means to motivate and initiate students' learning processes, i.e. acquiring a predetermined content and at the same time developing transferable personal competencies (interpersonal skills, critical thinking, etc.)' (Unece, 2009, p. 148). PBL is recognized as 'one of the more powerful teaching strategies to emerge in recent times' (Fink, 2003, p. 21). Its innovative educational potential is stressed in the ability to prepare students for change (Beringer, 2007; Cachinho, 2009; Savery, 2006), as the true essence of SL, and a vital educational goal on the scope for ESD (Brundiers, Wiek, & Redman, 2010).

Geographical Education can promote, in cooperation with other subjects, the action competence that is needed for such challenges (Haubrich, Reinfried, & Schleicher, 2007; Pawson et al., 2006). Learning to think about space and how to act in the middle are two competencies shared by Geographical Education and ESD, where the dimension space is critical and unifying learning (Carlos & Santos, 2010). Teach how to think about space acquires, therefore, new relevance to deal with issues like climate change, reduction of biodiversity, conservation and management of natural resources, among others, since we need to determine patterns and trends from a global scale and to understand its impact to the local community and vice versa (Reinfried, 2009). These issues arouse the importance of promoting critical thinking, as a process of making rational decisions about what to believe and what to do (Ennis, 1985), since allows students to adopt a critical stance in spatial thinking: evaluating the quality of spatial data based on its origin and its accuracy and reliability, and using spatial data to build, articulate and defend a line of reasoning or point of view to solve problems and answer questions, and evaluating the validity of arguments based in spatial information. The conceptual framework presented here is the result of the literature review on ESD principles and strategies, SL taxonomy, PBL methodology and CST. It is also an outcome of the literature review about good practices on ESD projects and teaching and learning strategies that have been produced since 2005 (first year of the ESD decade), presented on Scopus database. The reflection, based on the literature review, was combined with the results from a Focus Group interview, which aimed to discuss the student's spatial thinking and critical thinking skills, on the Portuguese educational context, which should be developed, in order to promote geographically competent citizens, on the scope for ESD.

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As main guidelines we should focus the importance of adopting the ESD principles for enhancing ESD processes within the educational community, of:

- 1) Collaboration and dialogue
- 2) Engaging the 'whole system'
- 3) Developing innovative curriculum as well as teaching and learning experiences; and
- 4) Improving active and participatory learning (Unesco, 2009).

These principles, combined with Fink's SL Taxonomy (Fink, 2003) point that, in order to develop an active and participatory learning approach, PBL is an adequate methodology, and that the main categories to develop CST skills, in the scope for ESD, are: Application, Integration, Human Dimension, and Caring. It's highlighted the major educational goals and the most adequate methodologies based on this framework. For instance, a major goal within the category of 'Application' should be: analyzing and critiquing issues and situations (critical thinking); for 'Integration': connecting different disciplines and perspectives (interdisciplinary learning); for 'Human Dimension': developing character and living by ethical principles (ethics, character building); and for 'Caring': developing a commitment to live right. Further results, regarding Focus Group discussion and relations between Spatial Thinking (Jo, Bednarz, & Metoyer, 2010) and Critical Thinking (Ennis, 1985) Taxonomies will be presented. We consider, on a wider context, that this study can have further impact on the reflection about the conception of teaching and learning strategies promoting SL in ESD, contributing to the review of implementation of the United Nations Decade of ESD. We also stress that there's a lack of research on the identification and systematization of CST skills, in general, and related to ESD in particular. On a specific context, this conceptual framework will guide the conceptualization of transdisciplinary strategies in a teacher training course, on the scope for ESD, as part of the ongoing research.

Abstract: This paper aims at proposing guidelines for the conception of significant learning experiences, to promote and foster student's critical spatial thinking, underlying an Education for Sustainable Development (ESD) approach. The conceptual framework is based on the literature review on ESD principles and strategies, significant learning taxonomy, problem-based learning methodology and critical spatial thinking, combined with the results from a Focus Group interview that aimed to discuss the student's spatial and critical thinking skills, to be developed in order to promote geographically competent citizens, on the scope for ESD. As main guidelines we stress the importance of adopting the ESD principles of: collaboration and dialogue; engaging the 'whole

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system'; developing innovative curriculum as well as teaching and learning experiences; and improving active and participatory learning. These principles, combined with Fink's Significant Learning Taxonomy point that, in order to develop an active and participatory learning approach, problem-based learning is an adequate methodology, and that the main categories to develop critical spatial thinking skills, in the scope for ESD, are: Application, Integration, Human Dimension, and Caring. We consider that this discussion can have impact on the reflection about the conception of teaching and learning strategies promoting significant learning in ESD. We also stress the lack of research on identifying and systematizing Critical Spatial Thinking skills, in general, and specifically related to ESD. This conceptual framework will also guide the conceptualization of transdisciplinary strategies in a teacher training course, on the scope for ESD, as part of the ongoing research.

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